

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
14 October 2004 (14.10.2004)

PCT

(10) International Publication Number
WO 2004/088094 A3

(51) International Patent Classification⁷: **F01L 13/00**,
1/344, 1/46, 1/18, 1/14, 1/24, 1/053

97828 Marktheidenfeld (DE). ENTEC CONSULTING
GMBH [DE/DE]; Im Beil 7, 58675 Hemer (DE).

(21) International Application Number:
PCT/EP2004/003264

(71) Applicant and

(72) Inventor: **BÖSL-FLIERL, Gerlinde** [DE/DE]; Brunnen-
strasse 62, 7661 Kaiserslautern (DE).

(22) International Filing Date: 26 March 2004 (26.03.2004)

(25) Filing Language: English

(72) Inventors; and

(26) Publication Language: English

(75) Inventors/Applicants (for US only): **FLIERL, Rudolf**
[DE/DE]; Brunnenstrasse 62, 67661 Kaiserslautern (DE).
HANNIBAL, Wilhelm [DE/DE]; Im Beil 7, 58675 Hemer
(DE). **JUBELT, Michael** [DE/DE]; Otto-Schuster-Strasse
49, 73760 Ostfildern (DE). **KNECHT, Andreas** [DE/DE];
Lustnauer Strasse 43, 72127 Kusterdingen (DE). **WILD,**
Andreas [DE/DE]; Bettweg 17, 72669 Unterensingen
(DE).

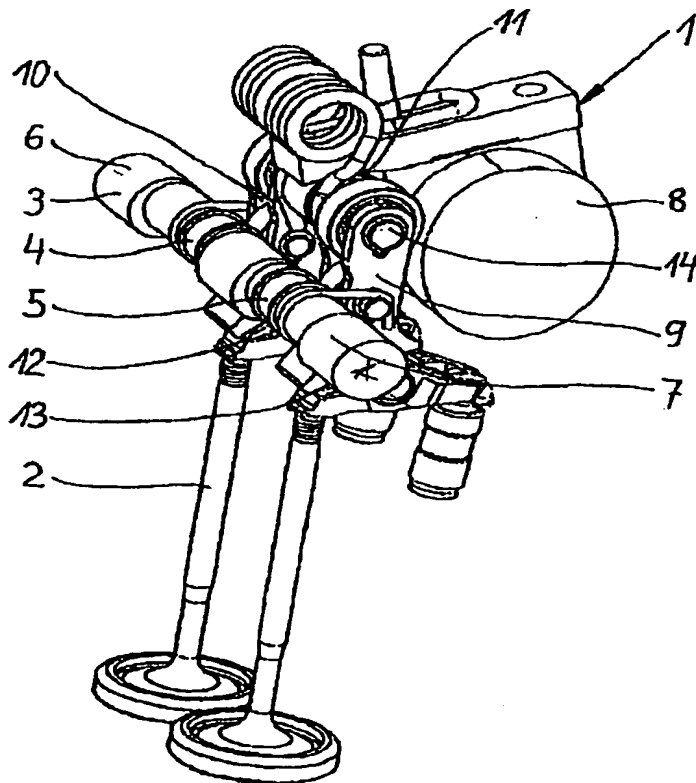
(30) Priority Data:
103 14 683.0 29 March 2003 (29.03.2003) DE
103 23 665.1 14 May 2003 (14.05.2003) DE
103 52 677.3 3 November 2003 (03.11.2003) DE
10 2004 001 343.8 8 January 2004 (08.01.2004) DE
10 2004 003 327.7 22 January 2004 (22.01.2004) DE

(71) Applicants (for all designated States except US): **HY-**
DRAULIK-RING GMBH [DE/DE]; Am Schlossfeld 5,

(74) Agents: **RICKER, Mathias** et al.; Jones Day, Prinzregen-
tenstrasse 11, 80538 München (DE).

[Continued on next page]

(54) Title: VARIABLE VALVE LIFT DEVICE FOR THE LIFT ADJUSTMENT OF GAS-EXCHANGE VALVES OF AN INTERNAL COMBUSTION ENGINE



(57) Abstract: In order to produce a variable valve lift device for the lift adjustment of the gas-exchange valves of an internal combustion engine, by means of which with adjustment forces and holding forces, independently from whether said holding forces and adjustment forces are applied mechanically, hydraulically or electrically, with an adjustment of the valve lift being as cost-effective as possible, and with maximum accuracy of the adjustment or control of the valve lift to be taken between the individual cylinders of a multi-cylinder internal combustion engine, and, moreover, the adjustment possibility of the valve lift of the valves of an internal combustion engine with several cylinders is obtained within smallest tolerances, it is suggested that a valve lift device (1) has a rotatable eccentric shaft (3), which consists of several eccentrics (4, 5) and whereby all possible contours of the eccentrics (4, 5) are positioned within a circle, which is formed by means of the external diameters of a bearing (6, 7) of the eccentric shaft (3).



(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,

GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) **Date of publication of the international search report:**

3 March 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/003264

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F01L13/00 F01L1/344 F01L1/46 F01L1/18 F01L1/14
F01L1/24 F01L1/053

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 373 818 A (UNGER HARALD) 20 December 1994 (1994-12-20) the whole document	1-3,7,8, 10-12, 14,20, 21,97
Y	US 5 601 056 A (KUHN PETER ET AL) 11 February 1997 (1997-02-11) claims; figure 3	1-3,7,8, 10-12, 14,20, 21,97
A	US 6 098 581 A (HIERETH ALEXANDER ET AL) 8 August 2000 (2000-08-08) the whole document	1,4-6
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

13 December 2004

Date of mailing of the international search report

07 JAN 2005

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Klinger, T

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/003264

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 0081, no. 74 (M-316), 10 August 1984 (1984-08-10) & JP 59 068508 A (HONDA GIKEN KOGYO KK), 18 April 1984 (1984-04-18) abstract; figures	1-3
A	US 5 215 048 A (KAISER HANS-JUERGEN ET AL) 1 June 1993 (1993-06-01) abstract; figures	14, 18
X	US 5 645 020 A (YAMADA YOSHIHIKO) 8 July 1997 (1997-07-08)	23-25, 27-29, 35-39
A	the whole document	54
X	EP 1 234 968 A (BAYERISCHE MOTOREN WERKE AG) 28 August 2002 (2002-08-28)	23-25, 33, 40, 42-47, 49, 50, 55, 58-60, 62, 63
	the whole document	
X	DE 42 23 172 C (BAYERISCHE MOTOREN WERKE AG) 19 August 1993 (1993-08-19) the whole document	65, 67, 70, 75, 99
A	US 2002/162522 A1 (MORRN BERNHARD) 7 November 2002 (2002-11-07) the whole document	76
A, P	DE 101 40 635 A (FLIERL RUDOLF) 24 April 2003 (2003-04-24) the whole document	76-81, 83-88, 97, 100
A	EP 0 111 768 A (FIAT AUTO SPA) 27 June 1984 (1984-06-27) the whole document	76
A	GB J06 650 A (PAXMAN & CO LTD DAVEY; WILLIAM WARNER JUDD) 14 October 1909 (1909-10-14) the whole document	76

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2004/003264

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,
no additional fees are to be refunded.

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-22,97

Variable valve lift device comprising a rotatable eccentric shaft, with the contours of the eccentric being positioned within a circle formed by the external diameter of a bearing of the eccentric shaft

2. claims: 23-39,98

actuator technology

3. claims: 40-64,99

device for the variable valve control or adjustment with a camshaft adjustment device

4. claims: 65-75

device for the variable valve lift adjustment comprising a multi-part eccentric shaft for the adjustment of the valve lift

5. claims: 76-96,100

variable valve lift control system for a combustion engine with underneath camshaft

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/003264

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 5373818	A	20-12-1994	DE	4326331 A1	09-02-1995
			EP	0638706 A1	15-02-1995
			JP	3245492 B2	15-01-2002
			JP	7063023 A	07-03-1995
US 5601056	A	11-02-1997	DE	4135257 A1	29-04-1993
			DE	4313656 A1	27-10-1994
			WO	9308377 A1	29-04-1993
US 6098581	A	08-08-2000	DE	19745761 A1	22-04-1999
			DE	29724388 U1	04-01-2001
			EP	0909882 A2	21-04-1999
JP 59068508	A	18-04-1984	JP	1060645 B	25-12-1989
			JP	1573153 C	20-08-1990
US 5215048	A	01-06-1993	DE	3933021 A1	18-04-1991
			DE	69004806 D1	05-01-1994
			DE	69004806 T2	17-03-1994
			EP	0494938 A1	22-07-1992
			ES	2047345 T3	16-02-1994
			WO	9105147 A1	18-04-1991
US 5645020	A	08-07-1997	JP	8240109 A	17-09-1996
			DE	19607982 A1	12-09-1996
			GB	2302160 A , B	08-01-1997
EP 1234968	A	28-08-2002	DE	10106921 A1	22-08-2002
			EP	1234968 A2	28-08-2002
DE 4223172	C	19-08-1993	DE	4223172 C1	19-08-1993
US 2002162522	A1	07-11-2002	EP	1255027 A1	06-11-2002
			AT	272787 T	15-08-2004
			DE	50103100 D1	09-09-2004
			ES	2185519 T1	01-05-2003
DE 10140635	A	24-04-2003	DE	10140635 A1	24-04-2003
EP 0111768	A	27-06-1984	IT	1157983 B	18-02-1987
			BR	8306947 A	31-07-1984
			EP	0111768 A1	27-06-1984
			ES	8501839 A1	01-03-1985
GB J06650	A	14-10-1909	NONE		